

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)



Applicant's or agent's file reference 208268/RV/jn	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/NL 03/00497	International filing date (<i>day/month/year</i>) 04.07.2003	Priority date (<i>day/month/year</i>) 11.07.2002
International Patent Classification (IPC) or both national classification and IPC F04B43/067		
Applicant Weir NETHERLANDS B.V. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

 These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:
 - I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

Date of submission of the demand 09.01.2004	Date of completion of this report 07.07.2004
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Poock, M Telephone No. +49 89 2399-2461 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/NL 03/00497**

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1, 3-9 as originally filed
2, 2a received on 18.05.2004 with letter of 17.05.2004

Claims, Numbers

1-11 received on 18.05.2004 with letter of 17.05.2004

Drawings, Sheets

1/4-4/4 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-11
	No: Claims	
Inventive step (IS)	Yes: Claims	1-11
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-11
	No: Claims	

2. Citations and explanations

see separate sheet

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**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/NL03/00497

1. For reasons of clarity (Article 6 PCT), claim 1 should be amended as follows:
In line 13 "(circular)" should be deleted because only reference signs can be used in brackets. In line 15, "the" should read "inner". In line 16 "formed" should read "defined".

The following statements are based on the assumption that such amendment are carried out in claim 1.

2. The closest state of the art diaphragm pumps are known from any of the documents cited in the search report.

The problem to be solved by the present invention may therefore be regarded as to provide a diaphragm pump with improved output capacity and optimum life span.

The state of the art revealed in the search does not contain any teaching for a clamping member with an asymmetrical circumferential inner edge as defined in claim 1. Therefore, the skilled person could not find an incentive in the prior art to include such feature in the known diaphragm pump in order to solve the problem posed. Consequently, the subject-matter of claim 1 meets the requirements of Article 33 (2)-(4) PCT.

3. Claims 2-11 are dependent of claim 1 and define preferred embodiments. They also meet the requirements of Article 33 (2)-(4) PCT.
4. The features of the claim/s are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

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stroke and the delivery stroke, one-way valves are mounted in the inlet pipe portion and in the outlet pipe portion, respectively, which valves guarantee a correct through-flow of the medium to be pumped.

The diaphragm pump of the aforesaid US Patent is mounted in a dead pipe portion of the pipe system, which application is very suitable for pumping slurries having a relatively high temperature. In the case of slurries having a lower temperature, it is less essential to protect the diaphragm pump from said hot, corrosive slurries, and the diaphragm pump may be mounted in the pipe system as mentioned in the introduction. For constructional reasons, the pipe system is disposed vertically, with the inlet being positioned below the outlet.

It has become apparent that hydrodynamic phenomena occur in the slurry within the diaphragm housing during operation of the diaphragm pump, which phenomena cause sufficiently large pressure differences between positions at the top of the diaphragm housing and positions at the bottom of the diaphragm housing, resulting in a disadvantageous deformation of the flexible diaphragm, in particular during the delivery stroke.

Said disadvantageous deformations of the flexible diaphragm place a limit on the extent to which the diaphragm can be loaded, which makes it necessary to select a larger diaphragm when the suction stroke volume has a particular value, so as to ensure a sufficiently long life.

The object of the invention is to provide a solution for the above problem and to provide a diaphragm pump in which the asymmetrical deformation of the diaphragm during operation is limited where necessary, so that the deformation of the diaphragm will increase elsewhere without this leading to an overload. Thus the output capacity of a selected diaphragm dimension will be maximally utilised whilst obtaining an optimum life span.

A diaphragm pump as described above is also disclosed in US Patent No. 3416461, US Patent No. 2405734, US Patent No. 5620746, Belgian

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Patent No.502350. European Patent Application No. 0524820 and French Patent No. 2164025. In these listed patent publications diaphragm pumps are disclosed having a circular shaped, flexible diaphragm movable accommodated in a housing. The diaphragms are each clamped down with their circular outer edge in the diaphragm housing by means of a circular shaped clamping member.

The clamping members as used in these listed patent publications exhibit a symmetrical circular shape still resulting in an a-symmetric deformation of the clamped diaphragm during use.

According to the invention, the diaphragm pump is to that end characterized in that the circular clamping member is provided, on

CLAIMS

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1. A diaphragm pump for pumping aggressive and/or abrasive media, such as slurries, comprising a diaphragm housing (29) mounted in a substantially vertically disposed pipe system (40), which substantially vertically disposed pipe system comprises at least one inlet (40a) and at least one outlet (40b) positioned some distance above the inlet, as well as at least one substantially circular, flexible diaphragm (25) having a circular outer edge (25a), which diaphragm is movable within the diaphragm housing under the influence of a working liquid (24) that can be pressurised, with the circular outer edge (25a) of the diaphragm being clamped down in the diaphragm housing by means of a circular clamping member (29a), wherein said clamping member (29a) defines a (circular) plane, characterized in that the circular clamping member is provided, on its the circumferential edge (29a') thereof, with a flange (50) that extends parallel to the plane formed by the clamping member.

2. A diaphragm pump according to claim 1, **characterized in that** the circular clamping member (29a) is provided with said projecting flange (50) substantially at the location of the outlet (40b) of the pipe system (40).

3. A diaphragm pump according to claim 1 or 2, **characterized in that** the projecting flange (50) is provided along the upper half of the circumferential edge (29a') of the clamping member (29a).

4. A diaphragm pump according to claim 3, **characterized in that** the length of the projecting flange (50) varies along the upper half of the circumferential edge (29a').

5. A diaphragm pump according to claim 4, **characterized in that** the length of the projecting flange (50) is greatest near the outlet (40b).

6. A diaphragm pump according to claim 4 or 5, **characterized in that** the length of the projecting flange (50) substantially equals

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zero in the middle of the circumferential edge (29a'), in particular up to about 30° below the middle of the circumferential edge.

7. A diaphragm pump according to any one of the preceding claims, **characterized in that** the end edge (50a) of the projecting flange (50) is curved.

8. A diaphragm pump according to claim 7, **characterized in that** the radius (R) of curvature of the end edge (50a) is approximately equal to the thickness of the diaphragm (25).

9. A diaphragm pump according to claim 7 or 8, **characterized in that** the curvature of the end edge (50a) is proportional to the counter curvature of the preformed diaphragm (25).

10. A diaphragm pump according to any one or more of the claims 7-9, **characterized in that** the radius of curvature of the end edge (50a) ranges from 8 to 80 mm.

11. A diaphragm pump according to claim 10, **characterized in that** the curvature of the end edge (50a) extends accordance to a second or higher degree polynomial.

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